



US009808853B2

(12) **United States Patent**  
**Frenken**

(10) **Patent No.:** **US 9,808,853 B2**  
(45) **Date of Patent:** **Nov. 7, 2017**

(54) **JAW PAIR FOR PUNCHING OUT HOLES**

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 396 days.

(21) Appl. No.: **14/235,879**

(22) PCT Filed: **Jul. 27, 2012**

(86) PCT No.: **PCT/EP2012/064753**

§ 371 (c)(1),  
(2), (4) Date: **May 15, 2014**

(87) PCT Pub. No.: **WO2013/017535**

PCT Pub. Date: **Feb. 7, 2013**

(65) **Prior Publication Data**

US 2014/0251104 A1 Sep. 11, 2014

(30) **Foreign Application Priority Data**

Aug. 2, 2011 (DE) ..... 10 2011 052 350

(51) **Int. Cl.**  
**B21D 45/00** (2006.01)  
**B21D 28/26** (2006.01)

(Continued)

(52) **U.S. Cl.**  
CPC ..... **B21D 45/006** (2013.01); **B21D 28/26**  
(2013.01); **B21D 28/34** (2013.01); **B26D**  
**7/1818** (2013.01);

(Continued)

(58) **Field of Classification Search**  
CPC . B21F 1/12; B21F 1/34; B26D 7/1818; B21D  
28/26; B21D 28/34; B21D 45/006  
See application file for complete search history.

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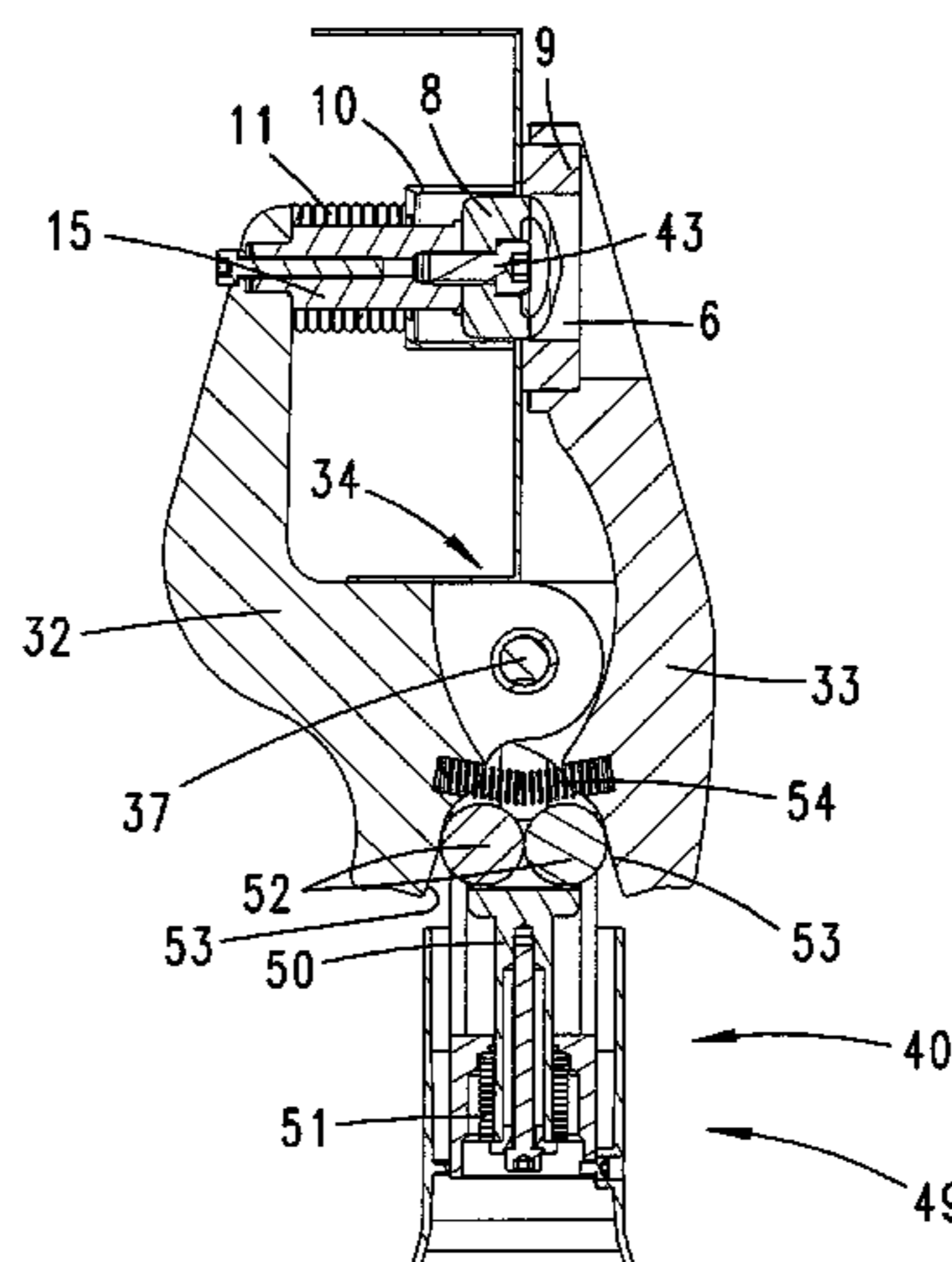
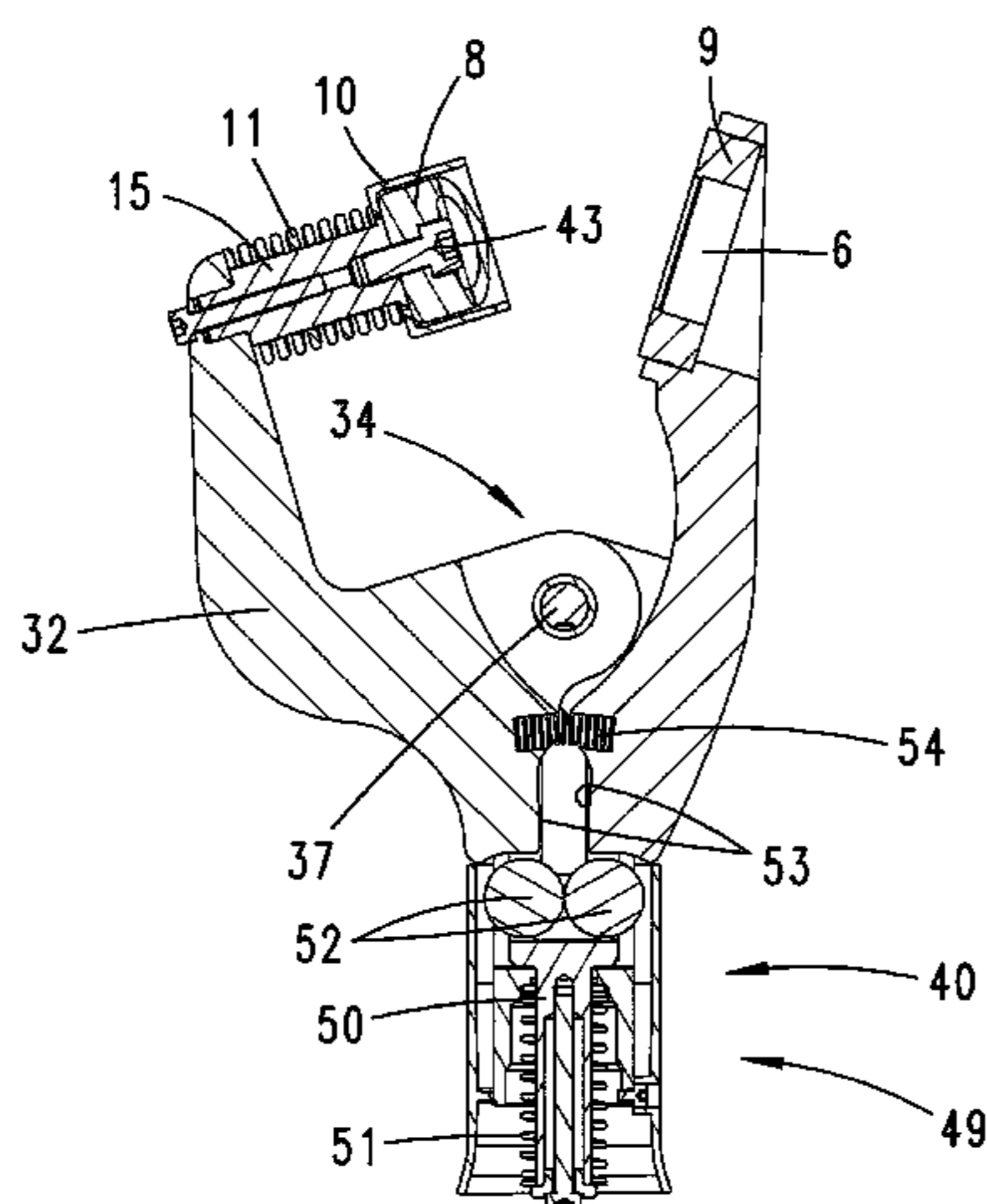
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IP LLP

(57) **ABSTRACT**

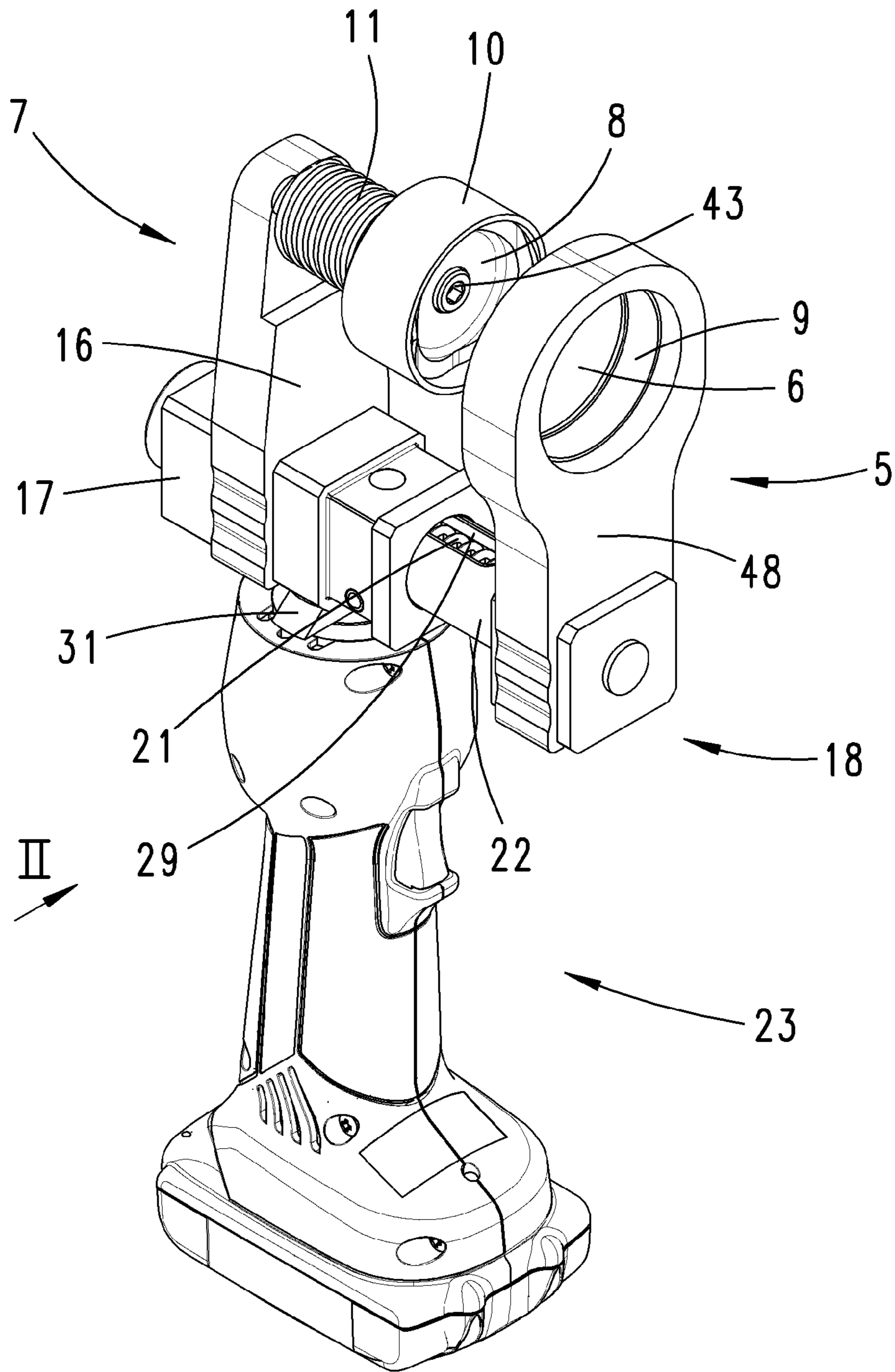
The invention relates to a jaw pair for punching out holes or recesses, preferably in sheet metal parts, the jaw pair being connectable to a device (23) to be operated preferably hydraulically and being designed, for example, as a pivoting jaw pair, wherein a punch (8) is formed on one jaw and a punching opening (6) is formed on the other jaw. To provide an advantageous jaw pair for punching out holes or recesses, preferably in sheet metal parts, it is proposed that a stripper part (10) which is situated outside of an outer contour of the punch (8) in the punching direction is formed in the jaw having the punch (8) and is movable in relation to the punch (8).

**20 Claims, 9 Drawing Sheets**

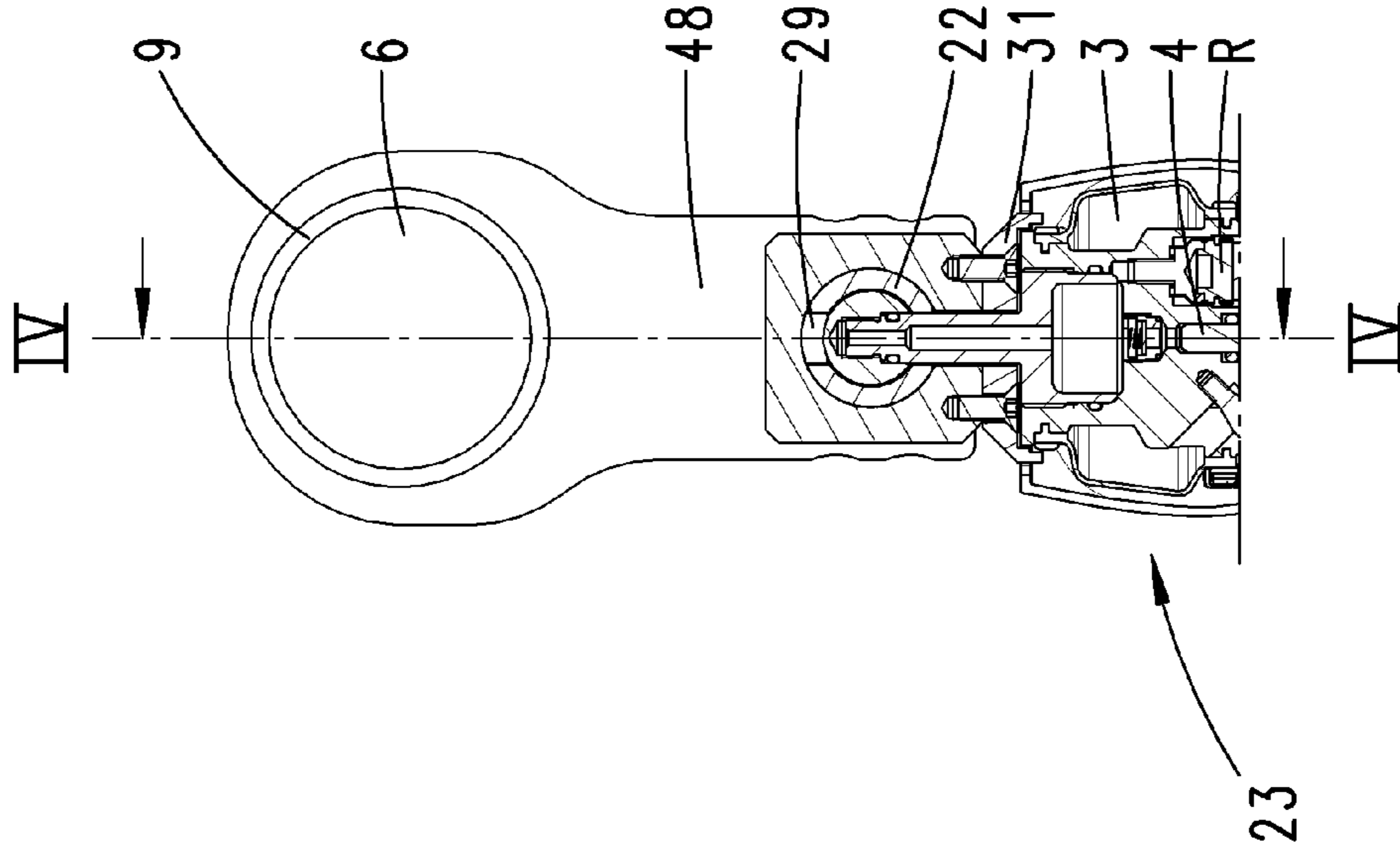




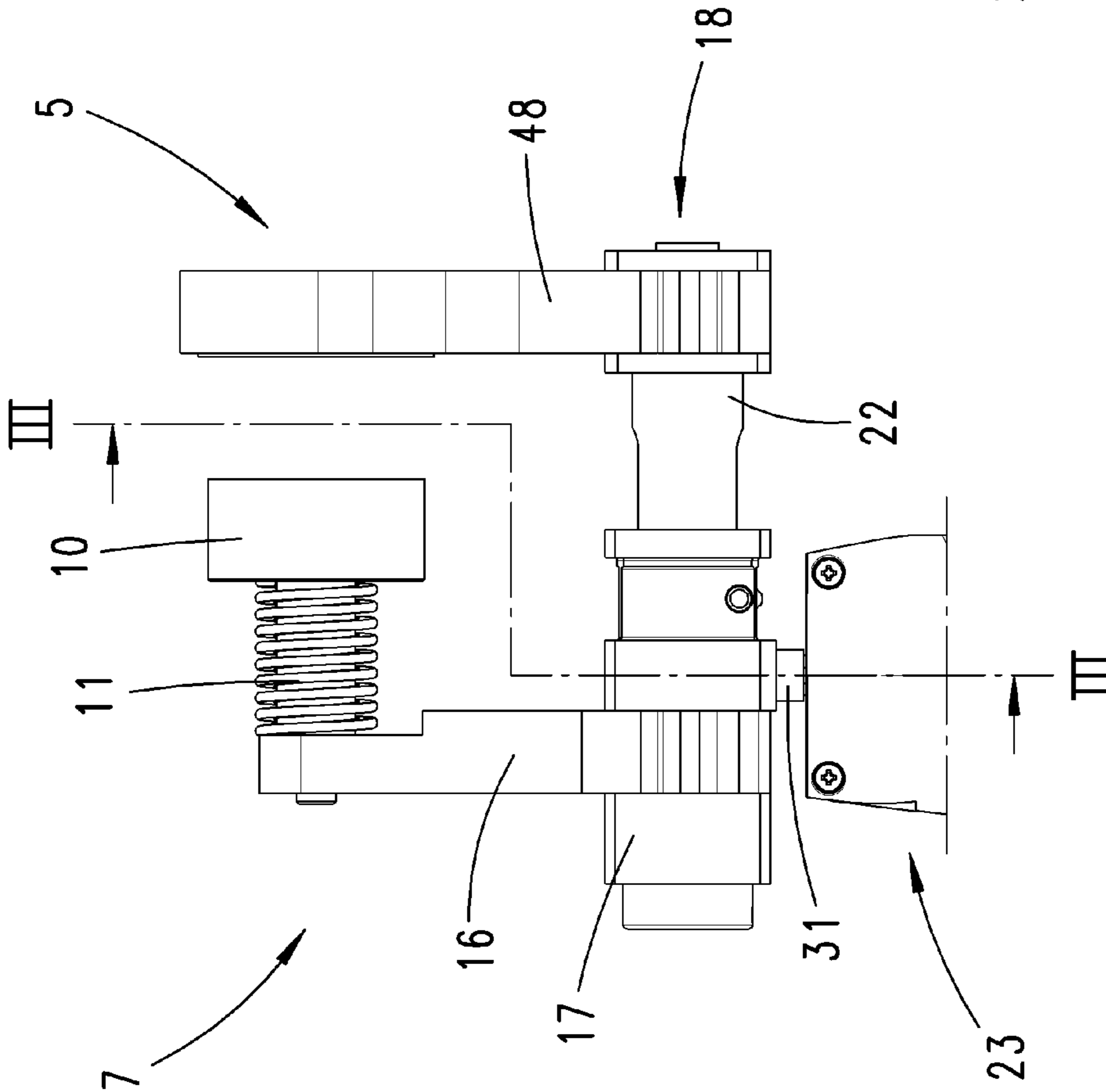
***Fig. 1***



**Fig. 3**



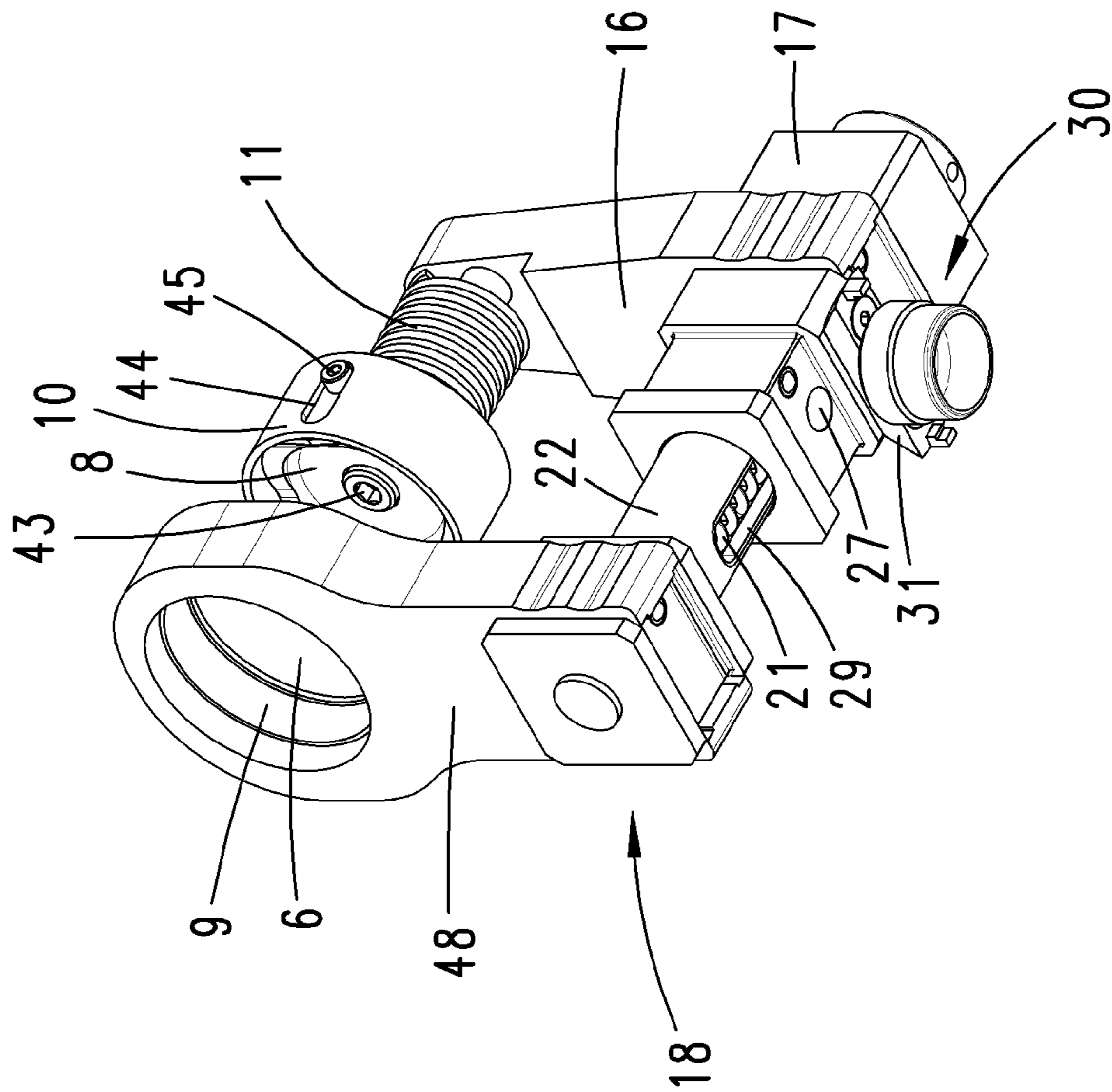
**Fig. 2**



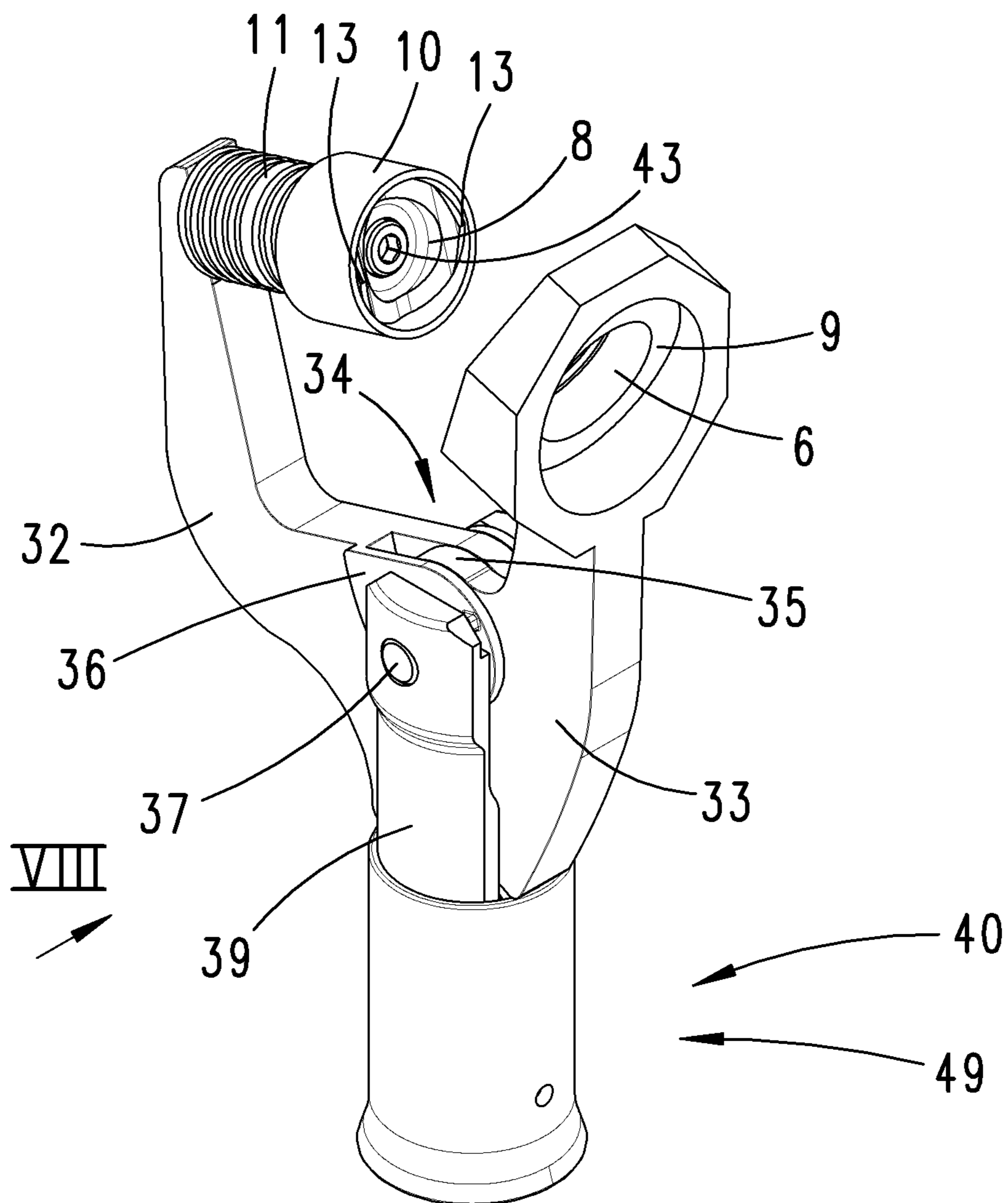


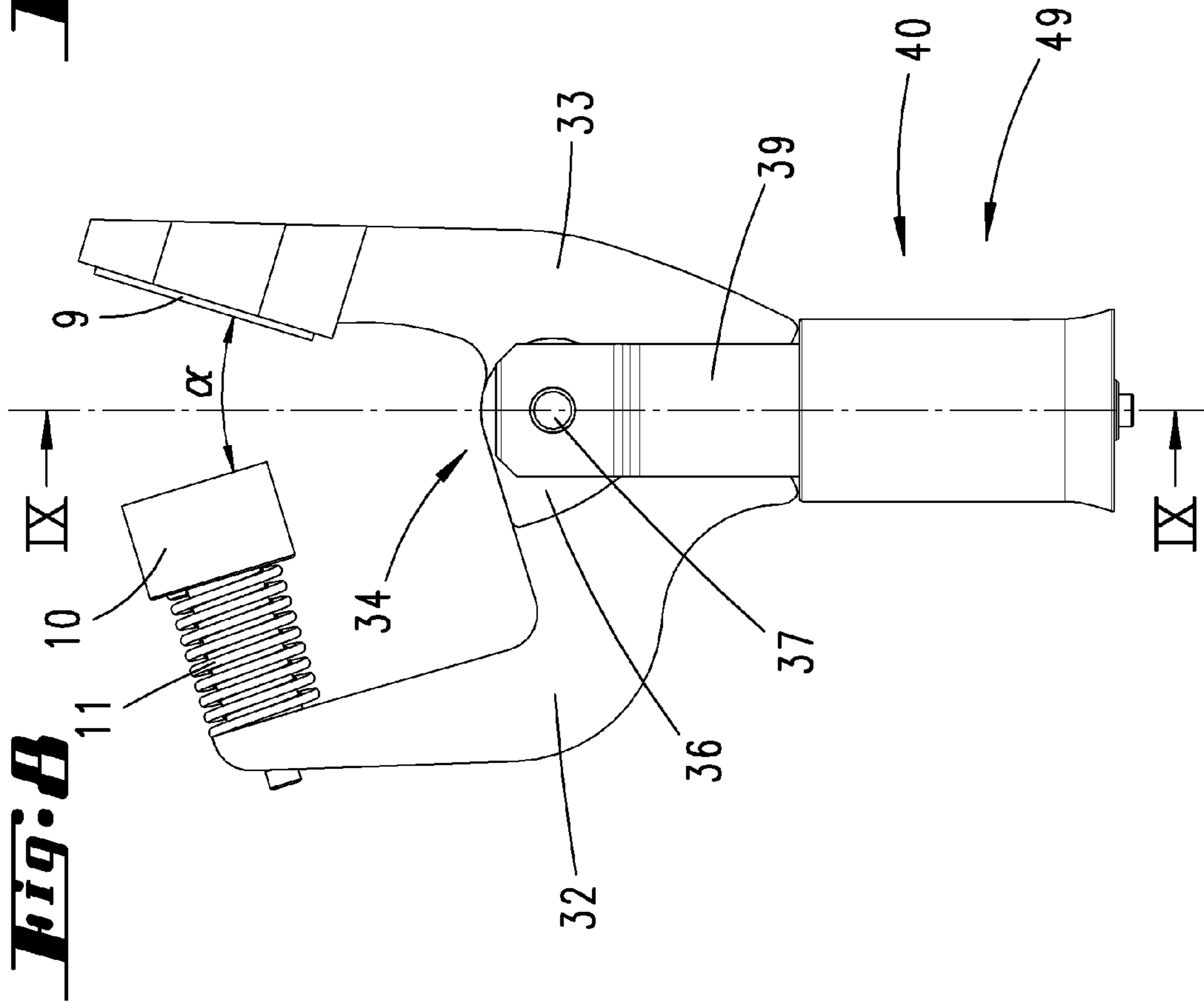
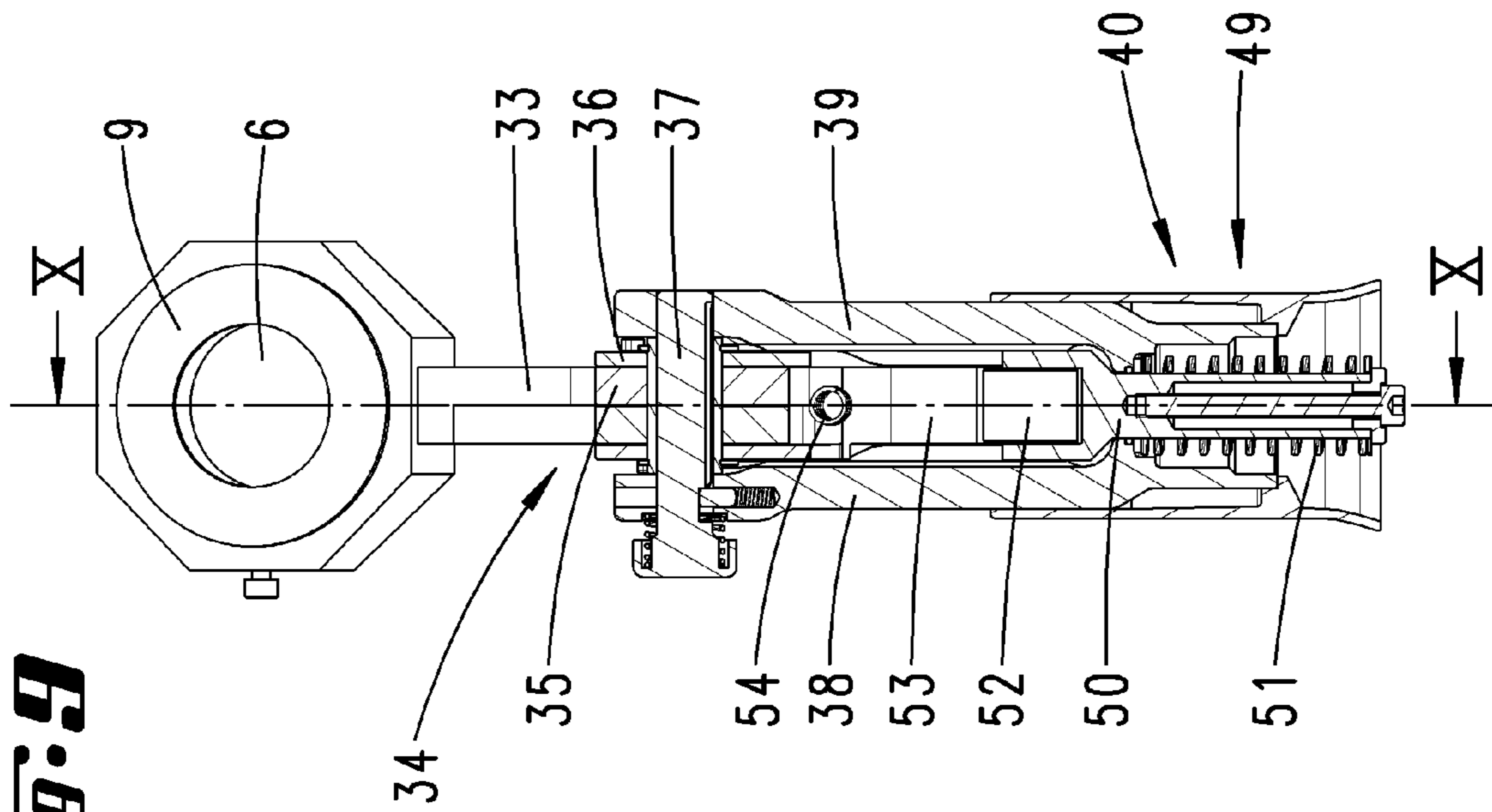


**Fig. 6**

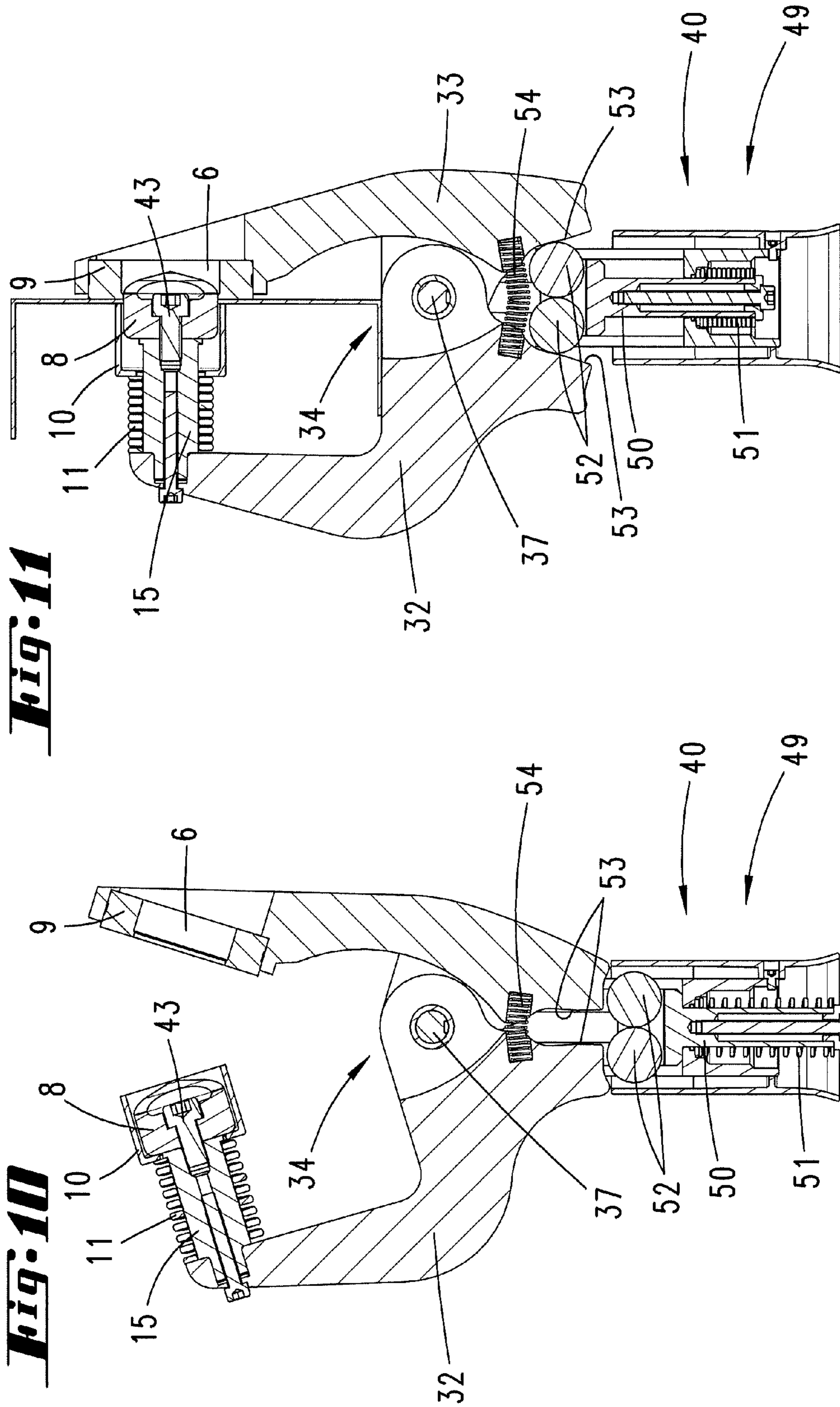


***Fig. 7***

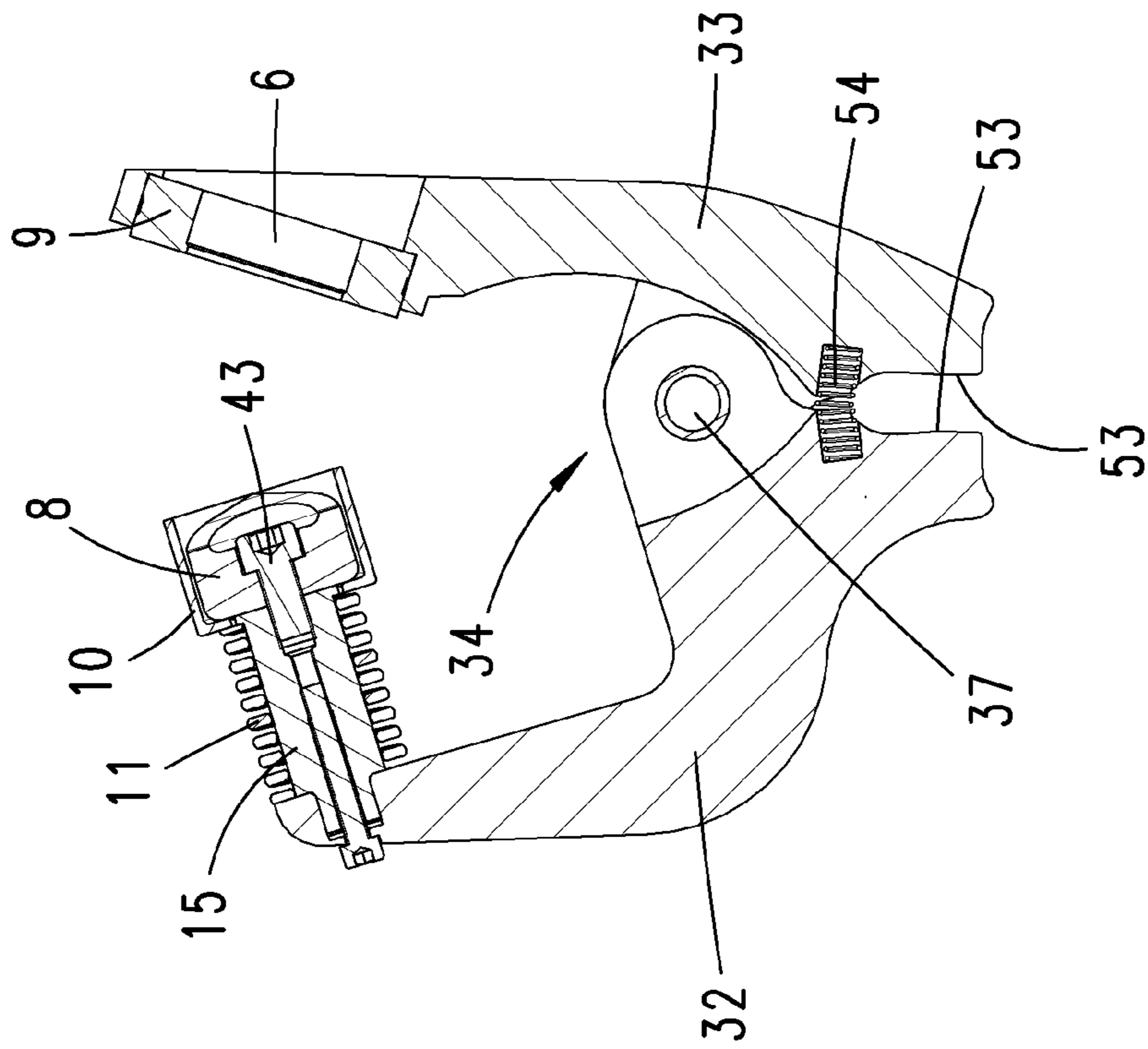




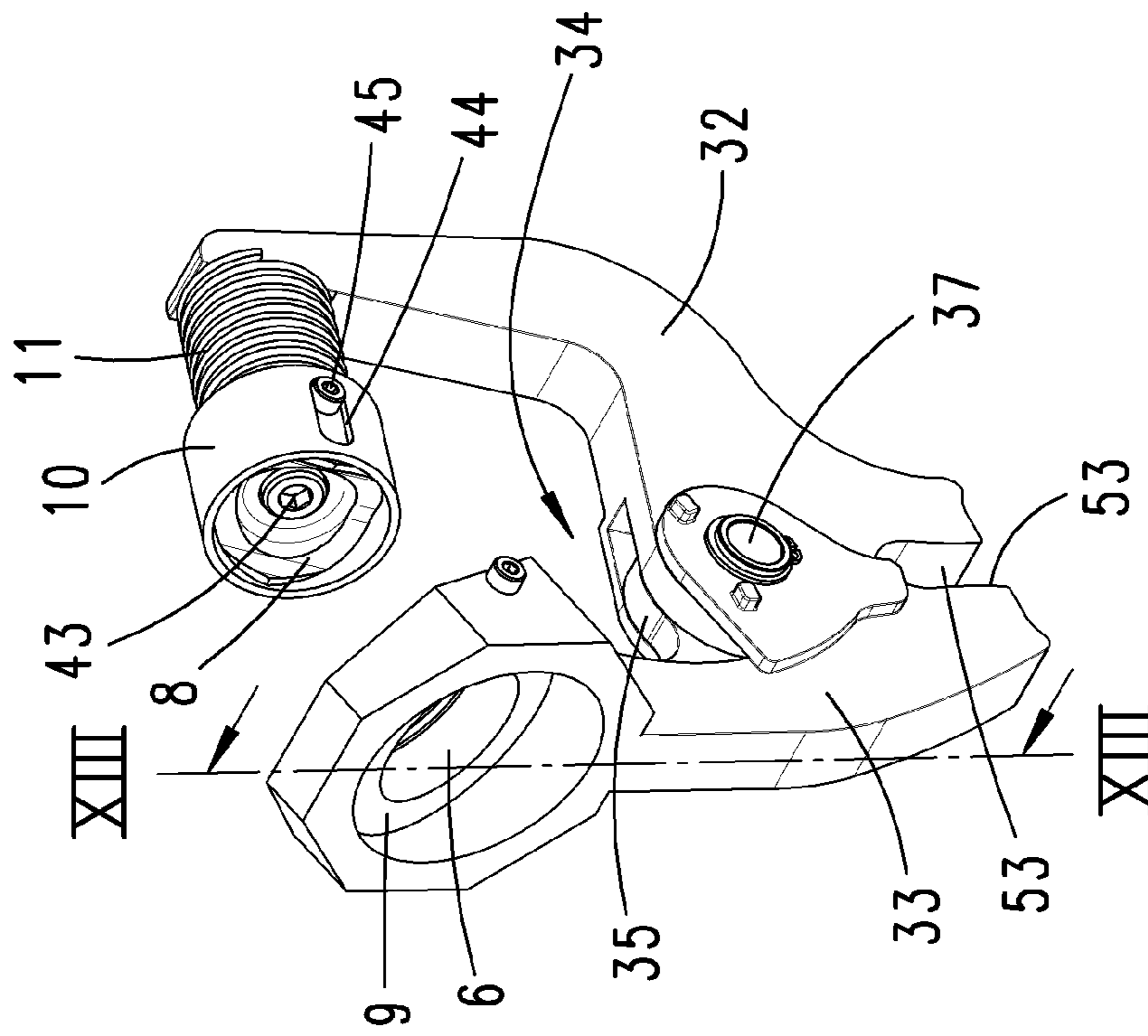




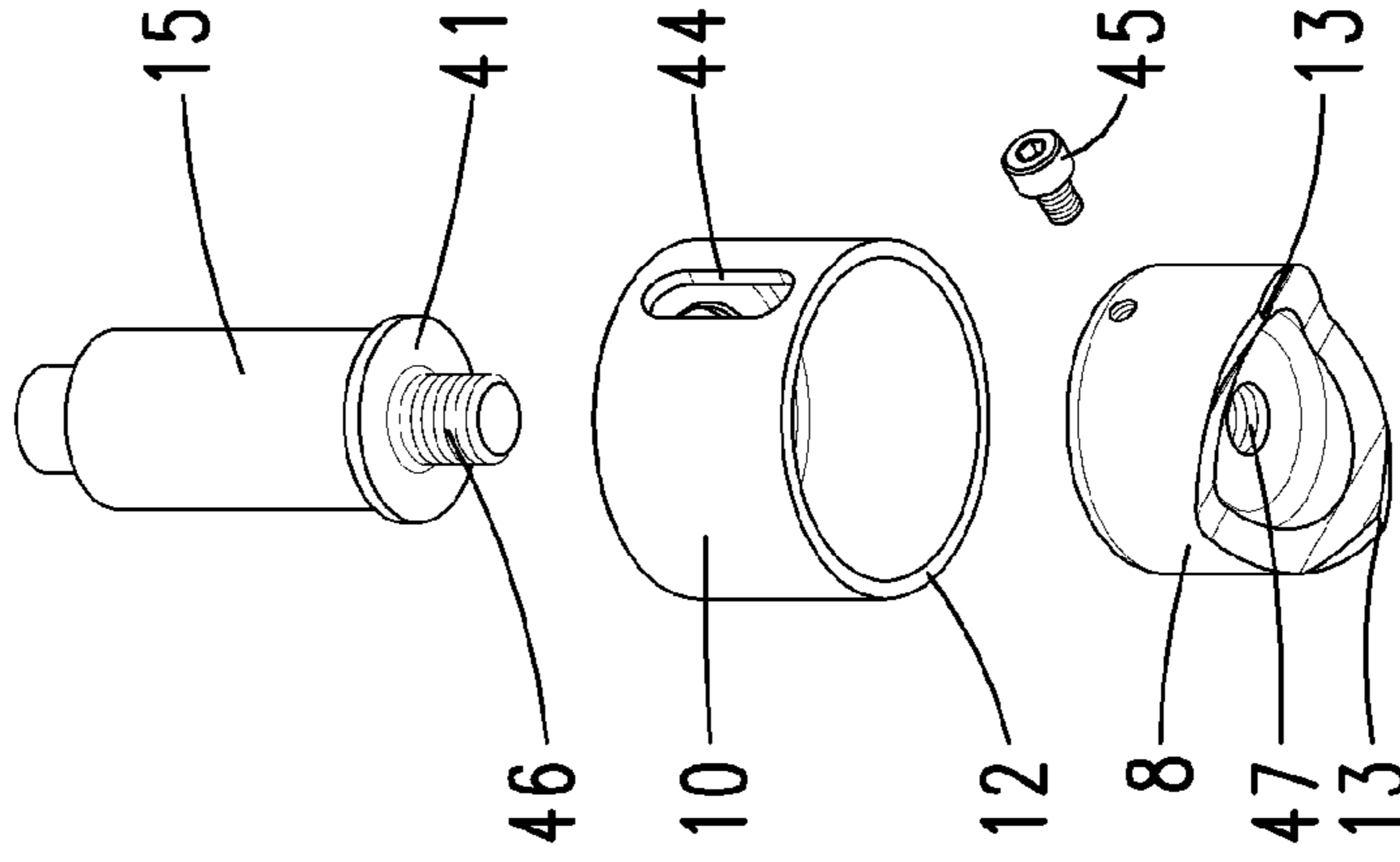
**Fig. 13**



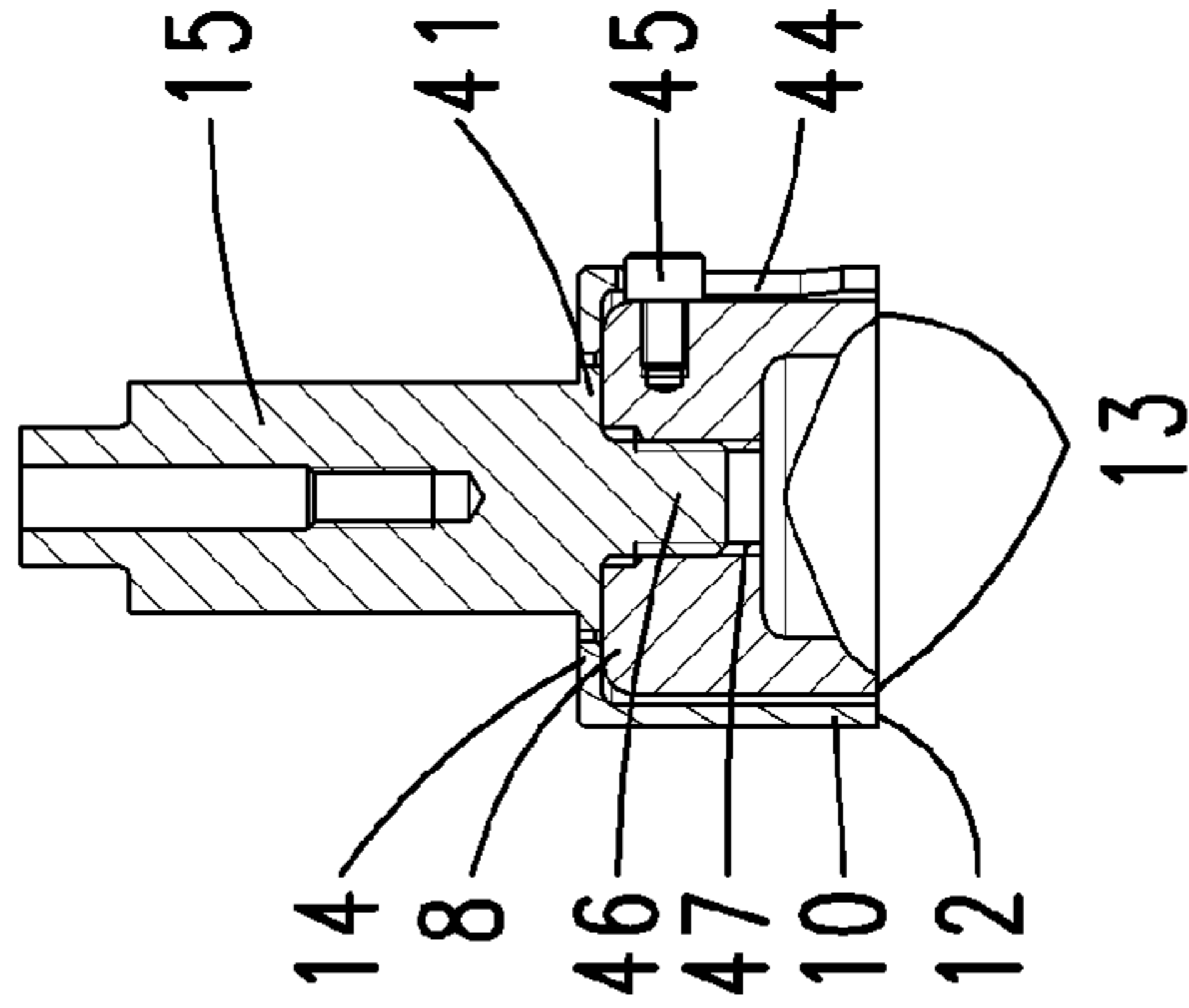
**Fig. 12**



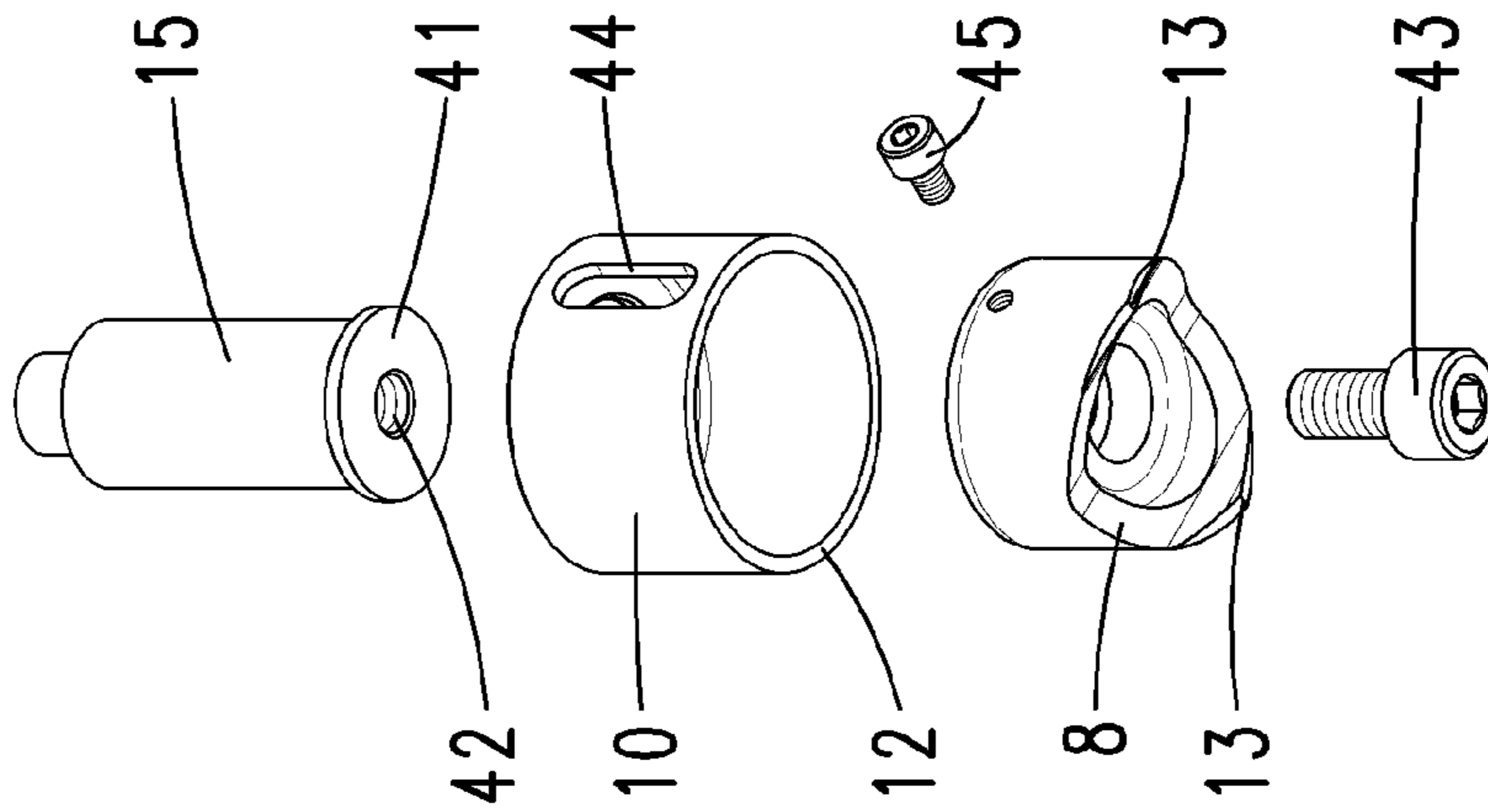
**Fig. 16**



**Fig. 15**



**Fig. 14**





**JAW PAIR FOR PUNCHING OUT HOLES**

## FIELD OF THE INVENTION

The invention relates to a jaw pair for punching out holes or recesses, preferably in sheet metal parts, formed as a pivoting jaw pair, for example, the jaw pair being connectable to a device to be operated preferably hydraulically, and a punch being formed on one jaw and a punching opening being formed on the other jaw.

## BACKGROUND OF THE INVENTION

Such jaw pairs are already known in various respects. Reference is made to DE 199 34 288 C1 and U.S. Pat. No. 6,427,515 B1, for example.

In addition, hydraulically operated devices on which such a jaw pair can be mounted are known in various embodiments. Reference is made in this regard to WO 99/04165 A1 and U.S. Pat. No. 6,206,663 B1, DE 198 54 943 A1, WO 99/19947 A1 and U.S. Pat. No. 6,276,186 B1, EP 1 084 798 A2 and U.S. Pat. No. 6,718,870 B1, and WO 03/084719 A2 and U.S. Pat. No. 7,412,868 B2.

With regard to the known punching device, a favorable operation is the goal. After the punch has broken through, there is sometimes jamming of sheet metal or other parts from which punching-out has taken place.

## SUMMARY OF THE INVENTION

Against this background, it is an object of the invention to provide an advantageous jaw pair for punching out holes or recesses, preferably from sheet metal parts.

According to a first inventive concept, one possible approach to this object is obtained with subject matter in which a stripper part situated outside of an outer contour of the punch in the punching direction, and movable in relation to the punch, is formed on the punching jaw having the punch. With such a jaw pair, in which one or both jaws execute(s) a movement in relation to the device in the course of performing a punching operation, this stripper part achieves the result that jamming of the device in the sheet metal part, for example, or entrainment of the sheet metal part on the jaw of the jaw pair having the punch after the end of the punching operation, can be counteracted. A sequence of punching operations can then be performed efficiently one after the other without hindrance.

Additional features of the invention are explained below and illustrated in the description of the figures and in the accompanying drawings, often in their preferred association with the concept already described above, but they may also be of importance in association with only one or more individual features, which are described or illustrated here, or independently, or in another overall concept.

It is thus preferable that the stripper part is biased into a position at least partially protruding beyond the punch at its free end. This bias makes it possible for the stripper part to move backward when the jaws come together, when the stripper part initially comes to rest on the workpiece, until the punch acts on the workpiece. Also in the course of this action, the stripper part initially moves farther backward, corresponding to the position of the punch in relation to the workpiece into which it is penetrating and/or through which it penetrates. After the end of the punching operation, when the jaws are moving apart again, the stripper part resting on the (remaining) workpiece assists the movement of the

punch away from the workpiece. Unless the bias force is exceeded, the workpiece is reliably lifted off the punch.

The stripper part may fundamentally be designed, for example, in the form of a plurality of stripper rods arranged preferably symmetrically and with equal circumferential spacing around the punch. However, a sleeve-like design of the stripper part is preferred. In this design, any remaining small parts are also reliably pushed back and ultimately stripped off when the jaws are opened.

It is also preferred that the bias of the stripper part is achieved by a mechanical spring, in particular a helical spring. The helical spring may be formed to surround a stationary securing part and/or a mount of the punch. One possibility is a circular securing part, which is accordingly surrounded by a helical spring extending in the manner of a cylindrical surface.

As an alternative to the formation of the jaw pair as a pivoting jaw pair, the jaw pair may also be formed as a sliding jaw pair. It has advantageously been found that the punch and the punching opening move parallel to one another, with coinciding central axes, in contrast to a movement on the (same) arc in the case of a pivoting jaw pair.

In another configuration of a sliding jaw pair, it is preferably provided that the punch jaws are accommodated in mutually displaceable mounts, and these mounts have a shared connecting fitting to the device. In particular with respect to a hydraulically operated device, this connecting fitting then also has the required hydraulic interface. The movement apparatus of the jaws of the sliding jaw pair is preferably provided on the jaw side of the connecting fitting. In this embodiment, the sliding jaw pair, which is exchangeably connectable to such a device, is provided together with the movement apparatus, preferably hydraulic, for the displacement of the jaws in relation to one another.

It is preferable in particular that the movement apparatus is a hydraulic piston/cylinder mechanism.

It is further preferable that the cylinder is movable, but the piston is stationary. It is likewise preferable that one jaw, more preferably the jaw having the punch, is stationary in relation to the device during a punching operation in the case of the sliding jaw pair, whereas the other jaw, preferably the jaw having the punching opening, is displaced in relation to the device. For an elongated device, as is also preferred in this context, the displacement is preferably carried out transverse to a longitudinal axis of the device, more preferably at right angles to the longitudinal axis of the device.

It is preferable that the movable cylinder part has an end which can be acted upon by hydraulic means and cooperates with the stationary piston part, and has a dry portion which extends beyond a bottom area of the piston part in the open position of the jaws and is similarly carried along when a punching stroke is performed, and which accordingly comes into partial overlap with the piston when the punching stroke is performed. The return spring, which causes the jaws to move back into their starting position after the hydraulic pressure is released, is preferably accommodated in the dry portion.

It is also preferable that one of the jaws, i.e., the jaw having the punch or the jaw having the punching opening, is fixedly connected to the stationary part or to the movable part of the movement apparatus.

The ranges and value ranges given above and in particular below also include all the intermediate values with regard to the disclosure, in particular in one-tenth increments of the stated dimension, optionally also dimensionless, for example,  $\frac{1}{10}$  degree,  $\frac{1}{10}$  diameter, etc., on the one hand to delimit the specified range limits from above and/or from



below, or alternatively or additionally, also with regard to the disclosure of one or more individual values from a respective stated range.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention is explained in greater detail below with reference to the appended drawings, which, however, merely represent exemplary embodiments, in which

FIG. 1 shows a perspective view of a device having a mounted sliding jaw pair;

FIG. 2 shows a side view of the device according to FIG. 1, in the upper region;

FIG. 3 shows a cross section of the subject matter according to FIG. 2, in a sectional view along line III-III;

FIG. 4 shows a cross section of the subject matter according to FIG. 2 and FIG. 3, in a sectional view in the plane IV-IV in FIG. 3;

FIG. 5 shows an illustration according to FIG. 4 of the jaws, in the moved-together state in the course of a punching operation;

FIG. 6 shows a perspective view of the jaw pair obliquely from below, mounted on the device according to FIG. 1;

FIG. 7 shows a perspective view of an alternative jaw pair formed as a pivoting jaw pair;

FIG. 8 shows a side view of the jaw pair according to FIG. 7;

FIG. 9 shows a cross section of the subject matter according to FIG. 8, in a sectional view in the plane IX-IX;

FIG. 10 shows a cross section of the subject matter according to FIG. 8 and FIG. 9, in a sectional view in the plane IX-IX in FIG. 9;

FIG. 11 shows an illustration according to FIG. 10 in the pivoted state, with a punching operation having been performed;

FIG. 12 shows another perspective view according to FIG. 7, without a device adapter;

FIG. 13 shows a cross section of the subject matter according to FIG. 12, in a sectional view in the plane XIII-XIII;

FIG. 14 shows an exploded illustration of the punch having a stripper part of a first embodiment;

FIG. 15 shows a cross section of the punch having a stripper part of a second embodiment; and

FIG. 16 shows an exploded illustration of the punch having a stripper part according to FIG. 15.

#### DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

A first embodiment of a hydraulic pressing device 1 having a jaw pair, formed here as a sliding jaw pair, is described and illustrated in first instance with reference to FIGS. 1 through 6.

The hydraulic pressing device in the exemplary embodiment is a pressing device, such as that also illustrated and described in the cited WO 03/084719 A2 (U.S. Pat. No. 7,412,868 B2). With reference to FIGS. 3 to 5, for example, the relationship to the subject matter described in the aforementioned WO document can be seen in the upper region, for example with respect to the return valve 2, the tank 3 and the pump ram 4. In other respects, reference is made to the full content of the cited WO and US documents for further explanation of the hydraulic device which is preferably used here, also for the purpose of incorporating features described in the WO and US documents with regard to the design of the device into claims of the present patent application.

The jaw pair of the first embodiment is explained in further detail with respect to FIGS. 2 to 6.

A first jaw 5 has a punching opening 6 and the second jaw 7 has the punch 8.

In further detail, as shown in FIG. 4, for example, the punching opening 6 is formed by a punch insert 9, which may be a metal ring part hardened by a suitable method, for example.

The punch 8 in the exemplary embodiment is formed so that it is circular in plan view, so that the punching opening 6 is also accordingly circular in plan view.

An angular design is also possible, such as that known from DE 10 2010 036 482 A1 (cf. FIG. 1 therein).

The punch 8 is surrounded by a stripper part 10, which is movable in relation to the punch 8 against the action of the compression spring 11 in the exemplary embodiment.

As shown in particular by a comparison of FIGS. 4 and 5, a front bordering edge 12 of the stripper part 10 is preferably formed overall as a sleeve in the exemplary embodiment and is arranged so that it is flush with one or more of the punch tips 13 formed on the punch 8 or also protrudes beyond them. The punch tips 13 are preferably formed on the edge, based on a contour outline of the punch 8. However, the stripper part 10 with its front bordering edge in the starting position may also be arranged so that it is set back in relation to a front region of the punch 8, in particular with respect to a punch tip 13. The punch may be formed with a profile in its front surface, as described, while the stripper part preferably extends with its front edge in a plane extending perpendicular to the punching direction.

In the exemplary embodiment, the stripper part 10 also has a bottom portion 14 with which it engages behind the punch 8. In this regard, a form-fitting mount is also achieved to prevent pulling off in the forward direction beyond the punch 8.

The punch 8 is also secured to a mount part 15 which extends in the punching direction and forms a support. This mount part 15 is preferably cylindrical in the exemplary embodiment. The compression spring 11 surrounds the mount part 15, preferably configured as a helical spring.

The mount part 15 is in turn secured at its foot at its end facing away from the punch 8, on a securing part 16 extending at an angle to the mount part 15. In the exemplary embodiment and preferably, the securing part 16 extends at right angles to a longitudinal axis of the mount part 15.

By means of the securing part 16, the punch 8 is ultimately secured on the sliding device 18, preferably on a housing 17 of the sliding device 18 of the jaw pair.

The jaw having the punching opening 6 merges directly into a mount 48, in a manner of speaking.

In further detail, the sliding device 18 comprises a piston part 19 and a cylinder part 20, and further comprises a return spring 21.

The piston part 19 and the cylinder part 20 are accommodated concentrically with respect to one another in the housing 17. A receptacle 22 in which the return spring 21 is accommodated is formed in an extension of the cylinder part 20. The cylinder part 20 and the receptacle 22 are formed in one piece or are connected for movement together.

Whereas the piston part 19 is stationary in relation to the device 23 when operated, as is also the case for the housing 17, the cylinder part 20 moves together with the receptacle 22. To this end, hydraulic fluid is pumped out of the device 23 and into the piston part 19 through a connecting line 24, forming a hydraulic connection, for which purpose in particular a bottom borehole 25 of the piston part 19 is connected to the connecting line 24.



In further detail, the piston part **19** is designed in the form of an elongated cylindrical part having, in its interior, a recess **26**, which is also cylindrical, as can be seen here. The elongated design of the piston part **19**, wherein the length *L* of the piston part preferably corresponds to approximately two to five times the diameter *D* of the piston part, ensures stable guidance of the cylinder part **20** which is movable in relation thereto.

Furthermore, it is apparent that the housing **17** has a cross bolt **27** which at the same time also forms a support for the return spring **21** at one end. At the other end, the return spring **21** is supported on a base **28** of the receptacle **22**. With respect to the cross bolt **27** or a location of the housing **17** in this regard, the piston part **19** and the return spring **21** extend in opposite directions.

The jaws are secured directly on the housing **17** by means of the securing part **16** and the mount **48**, and are thus stationary with respect to the device **23** in the connected state; i.e., the jaws are secured on the receptacle **22** by means of the mount **48**. The jaws are fixedly secured. The securing part **16** and the mount part **48** cannot move in relation to the housing **17** and the receptacle **22**, respectively. The described mounts of the jaws, which are connected to one another by means of the sliding device **18**, together with the sliding device **18**, are also connected or can be connected to the device **23** by means of a shared connecting fitting **30**. The piston/cylinder unit of the sliding device **18** is formed on the jaw side of the connecting fitting **30**.

As a result of pressurized filling of the recess **26** with hydraulic fluid, the cylinder part **20** is moved out of the position according to FIG. **4** into the position according to FIG. **5**. Since the receptacle **22** is also moved in this way, the return spring **21** is correspondingly compressed and biased.

The cross bolt **27** is arranged in a portion of the housing **17** which extends beyond the piston bottom with respect to the connecting line **24**, and engages through two oppositely situated elongated holes **29** in the receptacle **22**.

The connecting line **24** is part of the connecting fitting **30** (also see FIG. **6**), which permits an operationally detachable connection of the unit of the jaws and the sliding device from the device **23**. The connecting fitting **30** can be screw-connected to the device.

In particular, the connecting fitting accordingly comprises the mechanical adapter, the screw connection, for example, and a cavity which merges into the connecting line **24** for conducting hydraulic fluid into and out of the piston part **19**. The connecting fitting **30** at the same time provides, via a neck-shaped configuration, that the mentioned unit of the jaws and the sliding device is at a distance from a facing end face of the device **23**. However, as in the exemplary embodiment, the connecting fitting is preferably screwed into this end face of the device **23** with the foot region having the threaded mechanism.

In addition, the jaw mechanism which is connected to the device **23** is supported overall on the device **23** by means of an attachment part **31** having an elongated shape. The attachment part **31** extends transversely with respect to a displacement direction of the jaws.

The further embodiment having pivoting jaws is explained with reference to FIGS. **7** to **13**.

The pivoting jaws **32**, **33** are connected in a pivot joint **34**. Beginning with the pivot joint, the pivoting jaws **32**, **33** on the device side are fundamentally configured in the same way as described in DE 10 2005 028 083 A1 and U.S. Pat. No. 7,216,523 B2. In this regard, the disclosure content of this publication is also hereby incorporated in full in the

disclosure of the present patent application, also for including features of this previously known document of the present patent application.

The bearing eyes **35**, **36** of each of the jaws **32**, **33** are configured with different thicknesses as measured in the axial direction of the bearing opening, as also described in the cited document. The bearing eye **35** is approximately three times thicker than the bearing eye **36**.

The inside distance between the two bearing eyes **36** and **35** corresponds approximately to the thickness of the bearing eye **35** having the greater thickness. In the mounted state, the jaws are aligned in relation to one another in such a way that the bearing eyes **35**, **36** intermesh. The bearing eye **35**, having the greater thickness, of the one jaw **33** is correspondingly arranged between the two bearing eyes **35** and **36** of the other jaw **32**. Thus, the bearing eyes **36** having the lesser thickness are situated on the outside of the jaw pair thus formed.

The mounting bolt **37** passes through the bearing openings **6** of the two jaws **32**, **33** in the mounted state.

As indicated in further detail from FIG. **9**, for example, the locking bolt **37** passes through two arms **38**, **39** of the mounting neck **40**. The locking bolt **37** may in particular be a bolt such as that known from EP 1 491 295 A1 and US 2005/0011236 A1. In this regard, the content of this document is also hereby incorporated in full in the disclosure of the present patent application, also for the purpose of including features of this document in claims of the present patent application.

Toward the free end, i.e., toward the punch **8**, the jaw **32** is formed differently from the jaw **33**. The jaw **32** has an angled shape in a side view according to FIG. **8**, such that a first jaw portion extends approximately horizontally in the open state of the jaws according to FIG. **7**, starting from the pivot joint **34**, while a second jaw portion extends approximately vertically. The punch **8** is then held on the other jaw portion, in principle in the same way as already described with respect to the jaw of the first embodiment.

In contrast, the second jaw **33** already extends approximately vertically in the position according to FIG. **7** and FIG. **8**, the second jaw portion of the jaw **32** and the jaw **33** diverging from one another, forming an angle  $\alpha$  of approximately  $30^\circ$  to  $60^\circ$ .

The pivoting jaws of the second embodiment are explained in greater detail with reference to FIGS. **10** to **13**.

FIGS. **10** and **11** illustrate a connecting fitting of this embodiment. In this regard, it is important that, corresponding to the teaching of EP 1 084 798 A2 and U.S. Pat. No. 6,718,870 B1, a piston shank **50** surrounded by a return spring **51** is already situated in the connecting fitting **49** with respect to the piston/cylinder arrangement formed in conjunction with the device **23**. In this embodiment as well, rollers **52** which cooperate with the corresponding acting surfaces **53** of the jaws are accommodated in the connecting fitting **49** on the jaw end of the piston shank **50**. In this embodiment, the jaws are further preferably biased into a position, which basically corresponds to the punching position, by a compression spring **54**.

FIG. **11** shows the position at the end of a punching operation, the piston **51** being hydraulically displaced by the connected device **23**, not shown in greater detail here.

FIGS. **12** and **13** show in perspective and cross sectional views, respectively, the arrangement of the jaws without the connecting fitting and in their open position.

With respect to FIGS. **14** to **16**, the design of the punch **8** and its mounting are also explained in further detail with regard to two possible embodiments.





spring engages with the bottom wall of the stripper part and does not engage with the plate of the mount in a second position.

2. The jaw pair according to claim 1, wherein a front edge of the stripper part is biased by the spring into a position protruding at least partially beyond the punch tip of the punch.

3. The jaw pair according to claim 2, wherein the spring surrounds the body of the mount.

4. The jaw pair according to claim 1, wherein the spring surrounds the body of the mount.

5. The jaw pair according to claim 1, wherein the punching opening has a metal insert mounted therein configured to receive the punch therein.

6. The jaw pair according to claim 1, further including a vertical handle, and wherein the first and second jaws are formed differently, the second jaw having an angled shape in a side view which is formed by a first generally horizontal portion extending from the handle and a second generally vertical portion extending from the first generally horizontal portion.

7. The jaw pair according to claim 1, in combination with a hydraulically operated device, the device being connected to the jaw pair.

8. The jaw pair according to claim 1, wherein the mount is separately formed from the second jaw and attached thereto.

9. The jaw pair according to claim 1, wherein the second jaw is pivotally connected to the first jaw.

10. The jaw pair according to claim 1, wherein the second jaw is slidably connected to the first jaw.

11. The jaw pair according to claim 1, wherein the punch is separately formed from the mount and attached to the mount.

12. The jaw pair according to claim 11, wherein the mount includes an opening into which a fastener is secured, the fastener securing the punch to the mount.

13. The jaw pair according to claim 11, wherein the mount includes a protrusion to which the punch is attached.

14. The jaw pair according to claim 13, wherein the protrusion is threaded and the punch is threadedly attached thereto.

15. The jaw pair according to claim 1, wherein the mount is separately formed from the second jaw and attached thereto, and the punch is separately formed from the mount and attached to the mount.

16. The jaw pair according to claim 15, wherein the mount includes an opening into which a fastener is secured, the fastener securing the punch to the mount, the fastener being detachable from the mount to detach the punch from the mount.

17. The jaw pair according to claim 15, wherein the mount includes a protrusion to which the punch is configured to be attached and configured to be detached.

18. The jaw pair according to claim 1, wherein the punch is detachable from the mount, and wherein the second end of the spring is engaged with the plate of the mount when the punch is detached from the mount.

19. The jaw pair according to claim 18, wherein the mount includes an opening into which a fastener is secured, the fastener securing the punch to the mount, the fastener being detachable from the mount to detach the punch from the mount.

20. The jaw pair according to claim 18, wherein the mount includes a protrusion to which the punch is configured to be attached and configured to be detached.

\* \* \* \* \*



UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 9,808,853 B2  
APPLICATION NO. : 14/235879  
DATED : November 7, 2017  
INVENTOR(S) : Frenken

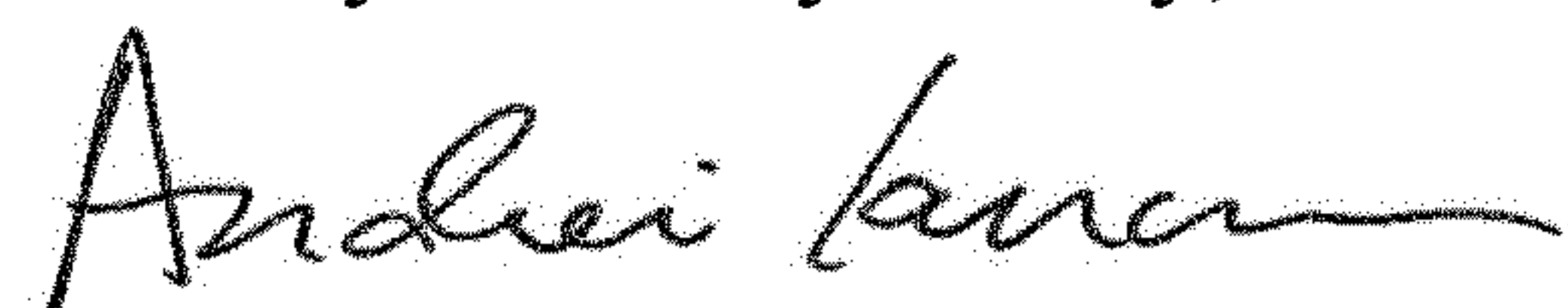
Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In Column 3, Line 32, delete "IX-IX" and insert -- X-X --, therefor.

In Column 5, Line 22, delete "mount part 48" and insert -- mount part 15 --, therefor.

Signed and Sealed this  
Thirty-first Day of July, 2018



Andrei Iancu  
*Director of the United States Patent and Trademark Office*